

SUPPLEMENT TO “MANAGERS AND PRODUCTIVITY IN THE PUBLIC SECTOR”

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APPENDIX B: THE MODEL

I BEGIN BY ASSUMING that each type of claim  $v$  is produced according to a simple log-additive production function

$$c_{vit} = \exp(A_{it} + M_{m(i,t)} + I_{m(i,t)})K_{it}^a h_v(L_{vit}), \tag{S1}$$

where total factor productivity  $A_{it}$ , managerial talent  $M_{m(i,t)}$ , factor intensity  $I_{m(i,t)}$ , and capital  $K_{it}$  are office-wide.  $h_v(\cdot)$  is a task-specific effective labor that translates labor inputs (chosen by the manager) into claim-specific labor output.  $L_{vit}$  is the vector comprised of labor inputs of different worker types indexed by  $\ell$ . Workers of type  $\ell$  have comparative advantages at producing different types of claims. Let their claim-specific ability be  $\omega_v^\ell$  and let  $h_v(L_{vit}) = \frac{\sum_\ell \omega_v^\ell L_{vit}^\ell}{L_{it}^a}$ .<sup>1</sup> Abusing notation slightly, let  $L_{it}$  be the number of workers at the office  $L_{it} = \sum_\ell L_{it}^\ell$ .

The standard index of output claims is a weighted sum of claims produced,  $Y_{it} = \sum_{v=1}^V c_{vit} \times w_{vt}$ , and its production can be represented directly in a modified Cobb–Douglas form:

$$Y = \exp(A_{it} + M_{m(i,t)} + I_{m(i,t)})K_{it}^a \underbrace{\sum_v w_{vt} h_v(L_{vit})}_{H(L_{it})}, \tag{S2}$$

where  $H(L_{it}) = \sum_v w_{vt} h_v(L_{vit})$  is the labor aggregate.

Managers affect production in several ways. More productive managers can have a direct effect by being more motivational via  $M_{m(i,t)}$ . More productive managers may also be more demanding, increasing the intensity  $I_{m(i,t)}$  with which production factors are used. Finally, more productive managers may make better task allocation decisions  $L_{it}$ . And despite institutional constraints, better managers may even have some limited ability to change worker composition, and hence average productivity (Hoffman and Tadelis (2018)) and office size  $L_{it}$  (Lucas (1978)).

To some approximation, the principal’s objective is to maximize  $Y$  subject to quality constraints. Under this simple formulation and if the quality constraints are not binding, the optimal task assignment with full information is to assign workers of type  $\ell$  to tasks where they have the highest marginal product, which is proportional to  $\omega_v^\ell w_v$ . However, managers do not necessarily maximize the principal’s objective.

Managers’ utility  $u$  is derived from both pecuniary sources (e.g., more consumption via larger bonuses or potential for promotion) and nonpecuniary sources (e.g., individual

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<sup>1</sup>If all workers have the same ability, (S1) becomes a Cobb–Douglas.

preferences on office performance). For instance, managers may place a higher value on quality or certain tasks,  $\tilde{w}_{vt}$ . Moreover, managers must make choices without full information. Managers can be thought as perceiving workers' abilities  $\tilde{\omega}_v^\ell$  (true ability plus noise). Better managers (for instance, those with higher  $M_{m(i,t)}$ ) are better judges of ability and receive a less noisy signal. Managers assign tasks to workers of type  $\ell$  to maximize their marginal utility, proportional to  $\tilde{\omega}_v^\ell \tilde{w}_v$ , rather than the marginal product defined by the principal.

This simple formulation highlights two important features of my setting. First,  $w_v$  is well-defined and salient to managers. Second, managers are incentivized to achieve the principal's objective.

Altogether, a better manager is the sum total of their decisions. This yields observed output

$$Y_{it}^* = \exp(A_{it} + M_{m(i,t)} + I_{m(i,t)}^*) K_{it}^a H(L_{it}^*), \quad (\text{S3})$$

where  $(I_{m(i,t)}^*, L_{it}^*) = \arg \max_{I_{m(i,t)}, L_{it}} u(I_{m(i,t)}, L_{it})$ .

The Italian context suggests some simplifying assumptions. All production employees work on the same software, and labor is the main input of production. There are virtually no differences in per-worker physical capital across sites and little scope for manager input. I specify total physical capital as  $K_{it} = k_t \times L_{it}$ , the product between a per-worker capital component  $k_t$  that does not vary across offices, and office size.

I decompose total factor productivity into an office-specific component  $\alpha_i$ , an aggregate shock  $\nu_t$ , an office-specific trend  $\zeta_{it}$ , and a transitory shock  $\epsilon_{it}$ , that is,  $A_{it} = \alpha_i + \nu_t + \zeta_{it} + \epsilon_{it}$ . Similarly, the combined effect of the manager's innate "ability" and their choice of office-wide factor intensity is given by the sum of a portable component of managerial talent  $\lambda_{m(i,t)}$  and an office-manager match component  $\eta_{im(i,t)}$ , that is,  $M_{m(i,t)} + I_{m(i,t)}^* = \lambda_{m(i,t)} + \eta_{im(i,t)}$ . Finally, I denote average productivity,  $\mu = \frac{H(L_{it}^*)}{L_{it}}$ .

Substituting and taking logs yields my main estimating equation

$$\ln P_{it} = \alpha_i + \underbrace{a \ln k_t + \nu_t}_{\tau_t} + \underbrace{\lambda_{m(i,t)} + \ln \mu_{m(i,t)}}_{\theta_{m(i,t)}} + \underbrace{\eta_{im(i,t)} + \zeta_{it} + \epsilon_{it}}_{u_{it}}, \quad (\text{S4})$$

or more compactly,  $\ln P_{it} = \alpha_i + \tau_t + \theta_{m(i,t)} + u_{it}$ .

## APPENDIX C: INCENTIVES

In this section, I provide an overview of the incentive-pay scheme for different classes of INPS workers and I discuss how financial and nonfinancial incentives may induce managers to sort into different office types.

### *The Incentive-Pay Scheme*

INPS implements an incentive-pay scheme to reward employees' performance. All employees' salary has a fixed component (*retribuzione tabellare*) and a bonus (*retribuzione accessoria*). The fixed component is tied to the job description. The bonus includes performance compensation. Total bonuses are the sum of ordinary and special bonuses, which are determined by the worker's office performance relative to office targets. Performance is measured by aggregating both the productivity and quality indicators to prevent managers from focusing on one dimension at the expense of the other. Production targets

are defined as the maximum between the nationwide productivity indicator in the previous year and the previous year office achievement. Refer to Section F of the Online Appendix for a detailed description of the formula used to compute bonuses.

*Ordinary Bonuses.* INPS provides quarterly bonuses to employees on the basis of the year-to-date performance of their office. Bonuses differ between managers and production line workers. Managers' bonuses are a function of the performance of both their office and the broader geographical region to which their office belongs. The geographic component of bonuses is intended to generate shared responsibility for public service provision in the region and ultimately foster cooperation among managers. Bonuses also differ between managers stationed at main offices and those serving in local branches, which I turn to next.

Ordinary bonuses of managers stationed in main offices are a linear function of performance relative to production targets. In particular, 56% of the performance compensation depends on the performance of the office they are in charge of relative to its production target, 14% is based on the performance of the region her site belongs to relative to its production targets, and the remaining 30% is awarded according to performance evaluations by their superiors.

Ordinary bonuses awarded to managers serving in local branches are a step function of office performance relative to its production target. Each manager is bumped up (down) one step if the region where the site is located outperforms (underperforms) its production target.

Ordinary bonuses for workers are an increasing step function of the performance of the region the office is located in relative to its production target. In principle, managers could differentiate bonuses between employees working at the same site, but this does not happen in practice.

*Special Bonuses.* INPS also provides bonuses that directly reward improvements in the quality of the service provided. More specifically, special bonuses are an increasing linear function of the improvement in the office quality indicator relative to its previous year and are awarded to both managers and workers.

### *Incentives and Sorting*

INPS' incentive scheme is designed to not reward managers simply for overseeing an innately productive office. First, performance is measured relative to the office production targets. Second, bonuses are both a function of office performance level and its improvement relative to the previous year. Managers stationed at productive sites may benefit from the permanent component of office productivity, but they also have a much harder time improving the office performance relative to the prior year. Conversely, managers serving in unproductive offices may be negatively impacted by the poor overall performance of the office, but can more easily improve office productivity and quality. All managers with a given job title are paid the same fixed nominal wage, but the cost of living differs substantially across regions. Northern Italy is on average more expensive than the South and small towns are often cheaper than major cities.

Financial incentives are only a subset of the incentives managers face and not necessarily the most important ones. Anecdotally, most managers move to be as close as possible to where their family lives (which typically coincides with their birthplace). Southern offices are in very high demand as 59% of are born in the South (Table I), but only 38% of

the offices are located in this region. Career concerns are unlikely to play a major role in this context as only a handful of managers are promoted during my sample period and most managers happen to be toward the end of their careers (Bertrand, Burgess, Chawla, and Xu (2019)).

Systematic preferences of managers for a particular geographical region or more or less productive offices do not represent a threat to my empirical strategy, an argument I lay out more formally in Section 4.1. One may also worry that, as the bonus is a function of the previous year achievements, this might generate cycles of high and low effort. However, this is not consistent with the evidence presented in Section 5.2 showing that the productivity gains are mostly driven by changes in the number of workers assigned to the office as opposed to changes in office output. Finally, one might be concerned that managers may sort to offices based on where they expect to receive the highest bonuses; this is akin to sorting based on comparative advantage. I test for this type of sorting in Section 4.3 and I find no evidence of sorting on comparative advantage.

#### APPENDIX D: DETAILS ON INSTITUTIONAL BACKGROUND

In this section, I provide additional details on the institutional background. More specifically, I discuss how INPS equalizes workloads across offices and how the quality index and weights are constructed.

*Equalizing Workloads Across Offices.* INPS optimizes its resource allocation to meet a demand that has a strong seasonal component and often exhibits idiosyncratic shocks. Given the many constraints related to hiring and firing bureaucrats, the Social Security Agency can either reallocate employees or workloads across sites. While reassigning workers to offices seems an appealing strategy, in practice, this is often not feasible. Workers cannot be forced to move from one site to another against their will and those who choose to move are relatively few as documented in Table II. To equalize workloads across offices and use resources effectively, INPS encourages managers to trade claims. Managers facing low demand are instructed to contact managers in high-demand offices and ask to be transferred a share of their claims. If the two managers agree on the trade, claims are transferred electronically and they count toward the production of the office that processes them. As INPS encourages trades across sites and the pay-for-performance scheme incentivizes managers to transfer claims from low- to high-demand offices, trades are anecdotally very common.

*Quality Index.* The quality index is measured as a weighted average of two components: the fraction of claims processed within the first 30 days (timeliness), and the fraction of claims that has to be processed twice because of an error in initial processing (error rate). The error rate includes all corrections that have been made to a claim after the transaction was closed for the first time. Errors are discovered in one of the following circumstances: First, when an employee realizes they made a mistake and they amend it; second, during one of the random audits (INPS audits 5% of the production of each office twice per year); third, if managers spot mistakes when reviewing or supervising their employees' work. Fourth, errors can be found when denied beneficiaries file an appeal. Anecdotally, the vast majority of errors are found during the audits and most of them are procedural (i.e., the employee did not follow the correct procedure) as opposed to substantial (i.e., the final decision to reject/accept a claim was wrong). My data does not contain the two subcomponents of the quality index (timeliness and error rate), direct information on the audits, the number of mistakes, and the number of appeals filed. Therefore, I cannot analyze these components separately.

*Weights.* The claim categories are very fine—there are more than 1000 types—and each category is assigned a weight representing how much time *should* take to process that specific claim type. For example, processing the paperwork associated with overdue pension benefits should take on average six minutes while evaluating a mortgage (i.e., *mutuo ipotecario*) should take on average four hours. As described in Section 3, the weights are used to aggregate the number of claims of different types processed by each office into a single output measure. Importantly, INPS complexity-adjustment formula uses *objective* weights as opposed to subjective scores. As part of the INPS quality control department, there is a team devoted to measuring weights and keeping them up to date. To construct the weight for product  $v$ , this team selects an excellent, an average, and a mediocre office and picks a representative sample of product- $v$  claims from each office. Then the team visits each site and records the amount of time each employee took to process each claim. At the end of this process, the weight is constructed by averaging all measurements across employees and offices. The same set of weights applies to all offices at a given time. Weights are adjusted if there is a technological improvement and the time required to process a specific claim shortens, or when the paperwork associated with a claim changes. INPS also puts in place a series of checks to ensure that the weights are measured accurately. For example, the INPS quality control team tracks backlog by product. If the backlog for a given product increases substantially across multiple offices, INPS reassess the weight assigned to that product. Importantly in this setting, the weights reflect an *objective* measurement of complexity and do not represent the subjective beliefs of either INPS, an external auditor, or the researcher.

#### APPENDIX E: EXCLUDING THE FRONT OFFICE

Front offices are holdovers from a time when people applied for benefits in person. These days beneficiaries either apply online or through tax consultants. They can learn about application procedures and eligibility criteria on the INPS website and can check the status of their application through the online portal. As such, front office operations are quite limited. Front offices provide information that can be found on the INPS website to beneficiaries who are non-technologically savvy. For example, a potential beneficiary may walk into the front office to learn whether she is eligible for disability insurance and what documents she should include in her application. Alternatively, a citizen may have applied for a pension and may want to inquire about the status of her application.

Measuring productivity in any customer-facing setting is challenging. In contrast with the other elements of the productivity indices, INPS measures front office output using the inputs—the time employees spend on front office duties. Thus, the measure bluntly captures the value of staffing the office without adjusting for the number of customers served or the complexity of their demands.

One may be concerned that because employees may sit idle in periods of low demand, my productivity measures may not be purely capturing output. Nonetheless, the difficulty of measuring front office productivity does not affect my estimates of manager productivity. First, front-office services depend on the demographic composition of the catchment area and macroeconomic shocks and they are unlikely to be correlated with manager effectiveness. Second, I construct an alternative measure of office productivity ( $\ln P_{it}^c$ ) that does not include front-office output and I estimate (6) using this alternative measure. The pattern of results is unchanged (Figure E.I). As an additional robustness check, I reestimate (1) using  $\ln P_{it}^c$  as my dependent variable, and I correlate manager fixed effects obtained from this model with those from (1). The correlation coefficient is 92%. Overall, I conclude that changes in front office operations are not driving my results.

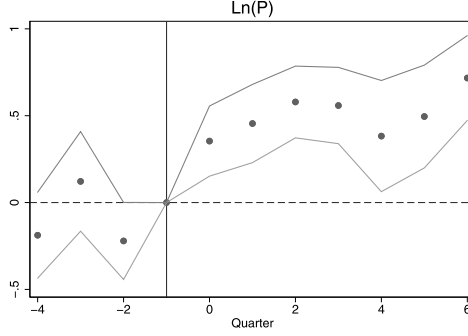


FIGURE E.I.—Robustness to the Exclusion of Front Office Output. *Note:* This figure mirrors Figures 3(a) and reports the reduced-form effects of managerial talent on office productivity measured without front office output. It reports the regression coefficients and the associated 95% bootstrapped confidence intervals for the linear specification, that is,  $\hat{\pi}_1^k$  from (6). The coefficient at  $k = -1$  is normalized to zero. The x-axis indexes event time.

#### APPENDIX F: THE BONUS FORMULA

In this section, I document in detail the formula that INPS uses to compute managers' bonuses and discuss how changes in office performance translate into bonuses. Because each office has one manager, I omit both manager  $j$  and time  $t$  subscripts for simplicity. Let  $k(i) \in \{M, L\}$  index whether manager  $i$  is in a main office or a local branch. Let  $\sigma \in \{o, s\}$  index whether a bonus is ordinary or special  $w_i^\sigma$ . Each category of bonus has a budget  $B_k^\sigma$ .

As mentioned in Online Appendix C, total bonuses are the sum of ordinary bonuses  $w_i^o$  and special bonuses  $w_i^s$ . The bonus formulas adjust equally apportionment of the budgets by the performance relative to average managers of the same type of branch

$$w_i^\sigma = \frac{a_i^\sigma}{\sum_{i':k(i')=k(i)} a_{i'}^\sigma / N_k} \frac{B_k^\sigma}{N_k}$$

Each type of branch  $k(i)$  has a total number of managers  $N_k$  and each category of bonus  $\sigma$  has a separate measure of performance  $a_i$ , which I lay out below.

##### *Ordinary Bonuses.*

*Main Offices ( $k(i) = M$ ).* For the ordinary bonuses of managers at main offices, performance is a weighted average of three piecewise linear components

$$a_i^o = 0.56f(x_{1i}) + 0.14f(x_{2,r(i)}) + 0.3x_{3i},$$

where:

1.  $x_{1i} = \frac{P_i}{\tilde{\tau}_i}$  is office productivity  $P_i$  relative to an office target  $\tilde{\tau}_i$ .  $\tilde{\tau}_i$  is defined as the maximum between the nationwide productivity indicator in the previous year and the previous year office achievement
2.  $x_{2,r(i)} = \frac{P_r}{\tilde{\tau}_r}$  is regional productivity  $P_r = \sum_{i:r(i)=r} \frac{FTE_i}{\sum_{i:r(i)=r} FTE_i} P_i$  relative to a regional target  $\tilde{\tau}_r$ .  $\tilde{\tau}_r$  is defined as the maximum between the nationwide productivity indicator in the previous year and the previous year region achievement
3.  $x_{3i}$  are individual performance reviews

and

$$f(x) = \begin{cases} 0, & x \leq 70, \\ x - 10, & x \in (70, 100], \\ 2x - 109, & x \in (100, 109], \\ 110, & x \geq 110, \end{cases}$$

a piecewise linear function of the component.

*Local Branches* ( $k(i) = L$ ). For the ordinary bonuses of managers in local branches, performance is a function of

1.  $x_{1i} = \frac{P_i}{\tilde{\tau}_i}$  is office productivity relative to an office target  $\tilde{\tau}_i$ , where  $\tilde{\tau}_i$  is defined as above
2.  $x_{2,r(i)} = \frac{P_r}{\tilde{\tau}_r}$  is regional productivity  $P_r$  relative to a regional target  $\tilde{\tau}_r$ , where  $P_r$  and  $\tilde{\tau}_r$  are defined as above

The function is easily described by a grid:

$a_i^o(x_{1i}, x_{2r(i)}), k(i) = L$	$x_{2r(i)} < 100$	$x_{2r(i)} \geq 100$
$x_{1i} \leq 95$	90	95
$x_{1i} \in (95, 100)$	95	100
$x_{1i} \geq 100$	100	110

*Special Bonuses.* For special bonuses, managers in both main offices  $M$  and local branches  $L$  are evaluated according to the same performance formula. However, instead of being rewarded based on productivity, they are rewarded based on quality where  $x_{4i} = \frac{quality_i}{\tilde{\tau}_i^O}$ . Performance for special bonuses is defined as

$$a_i^L(x_{4i}) = \begin{cases} 80, & x < 90, \\ x_{4i}, & x \in [90, 100], \\ 100, & x > 100. \end{cases}$$

The quality targets are based on quality from December of the previous year  $quality_{i,t-1}$ :

$$\tilde{\tau}_i^O(quality_{i,t-1}) = \begin{cases} 0.9\overline{quality}_{t-1}, & quality_{i,t-1} < 90, \\ \overline{quality}_{t-1}, & quality_{i,t-1} \in [90, 100], \\ \overline{quality}_{t-1}, & quality_{i,t-1} > 100, \end{cases}$$

where  $\overline{quality}_{t-1}$  is the national quality indicator in the previous year.

*Discussion.* As discussed in Online Appendix C, managers' bonuses are an increasing function of the office performance both in terms of productivity and quality of the service provided. The pay-for-performance system is designed to improve office performance by incentivizing managers of high-performing offices to keep high standards and induce managers of low-performing sites to catch up to the performance of the average office. I cannot decompose the variance in bonuses into separate productivity variances, quality

of service variances, and the covariance between the two because I, unfortunately, do not have earnings data.

I also cannot recover the distribution of elasticities of effort to bonuses because I do not have data on managers' effort. One may also be concerned that if the budget devoted to ordinary bonuses is significantly larger than the one devoted to special bonuses, managers may have an incentive to focus their effort on productivity at the expense of quality. This is not consistent with the evidence presented in Table IX that shows no trade-off between productivity and quality of the service provided.

## APPENDIX G: ADDITIONAL TABLES

TABLE G.I  
ESTIMATED EFFECTS OF CHANGES IN MANAGERIAL TALENT ON TIME ALLOCATION.

$k$	(1) Abs. Rate	(2) A(Training)	(3) A(Overtime)	(4) Ln(Hours)	(5) Ln(Wage Bill 30%)
-4	-0.014 (0.022)	0.180 (0.125)	0.031 (0.081)	0.000 (0.067)	-0.001 (0.068)
-3	-0.023 (0.016)	0.134 (0.130)	0.061 (0.069)	0.016 (0.059)	0.015 (0.059)
-2	-0.033 (0.016)	0.077 (0.091)	0.152 (0.082)	0.064 (0.046)	0.063 (0.046)
0	-0.016 (0.020)	0.004 (0.108)	-0.009 (0.082)	-0.198 (0.100)	-0.199 (0.103)
1	-0.007 (0.016)	-0.069 (0.123)	-0.082 (0.089)	-0.195 (0.075)	-0.194 (0.075)
2	-0.046 (0.019)	-0.308 (0.142)	0.003 (0.087)	-0.208 (0.082)	-0.207 (0.082)
3	-0.057 (0.020)	-0.376 (0.140)	-0.024 (0.070)	-0.172 (0.092)	-0.173 (0.091)
4	-0.074 (0.024)	-0.133 (0.133)	0.113 (0.083)	-0.161 (0.103)	-0.161 (0.102)
5	-0.037 (0.020)	-0.030 (0.138)	-0.003 (0.079)	-0.330 (0.101)	-0.331 (0.100)
6	-0.045 (0.026)	-0.093 (0.135)	-0.017 (0.091)	-0.421 (0.115)	-0.446 (0.126)
$N$	318	318	318	318	318
Time FE	Yes	Yes	Yes	Yes	Yes

*Note:* This table reports the reduced-form impacts of managerial talent on the office-time allocation. More specifically, it reports the coefficients  $\pi_1^k$  obtained estimating (6) on the balanced-analysis sample.  $N$  represents the number of office-quarter observations. The dependent variable,  $y_{it}$ , is reported at the top of each column and  $A(\cdot)$  is short for  $\text{asinh}$ . The wage bill is constructed as  $\text{wage bill}_{it} = 1 \times \text{hours}_{it} + 1.3 \times \text{overtime}_{it}$ . All models include time fixed effects, main effects, and two-way interactions between a dummy for Center-North, a dummy for main offices, a set of dummies for quartiles of baseline productivity, as well as time effects interacted with the dummy for Center-North.  $k$  indexes event time. Each coefficient is obtained from a separate regression. Bootstrapped standard errors are reported in parentheses.

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